DOCUMENT RESUME

ED 174 479 SE 028 615

AUTHOR	Hack, Nancy; And Others
TITLE	Selected Energy Education Activities for Pennsylvania Middle School Grades. Draft.
INSTITUTION	Pennsylvania State Dept. of Education, Harrisburg.
SPONS AGENCY	Governor's Energy Council, Harrisburg, Pa.
PUB DATE	79
NOTE	108p.
AVAILABLE FROM	The Pennsylvania State Univ., 336 Agricultural Administration, University Park, PA 16802 (no price quoted)
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Art Education; *Class Activities; *Elementary Secondary Education; *Energy; *Energy Conservation; *Environmental Education; Health Education; *Interdisciplinary Approach; Language Arts; Mathematics Education; Science Education; Social Studies
IDENTIFIERS	*Energy Education

ABSTRACT

These activities are intended to help increase awareness and understanding of the energy situation and to encourage students to become energy conservationists. The document is divided into sections according to discipline area. A final section is devoted to interdisciplinary activities involving several discipline areas integrated with the energy lesson. Each activity description contains: (1) discussion of grade level; (2) energy learning objective; (3) discipline area learning objective; (4) materials; (5) background information; (6) activity description; and (7) contact organizations for further assistance and information. (Author/RE)

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SELECTED ENERGY EDUCATION ACTIVITIES

FOR PENNSYLVANIA

MIDDLE SCHOOL GRADES

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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-1979-

SE 028 615

ACKNOWLEDGEMENT

The authors wish to express their sincere appreciation to Nance Tindal and Cathy Arney who typed and helped proof the content of these activities.

MESSAGE TO THE TEACHER

This booklet can be utilized in conjunction with the Pennsylvania Department of Education's guide entitled ENERGY - Pennsylvania's Energy Curriculum For The Middle Grades. The activities have been developed to help increase awareness and understanding of the energy situation and hopefully to encourage each individual to become an energy conservationist. In addition, the material represents an interdisciplinary approach and an attempt at providing a flexible document which may be altered to fit your local needs. Some of you may wish to begin with the Science Activity: Energy Vocabulary. Others may choose the Multidisciplinary Activity: The Energy Problem. Please scan the material and begin with the activity which best meets your needs. The activities may be reproduced or duplicated for student use.

If you would like to obtain additional curriculum material dealing with energy, request a complimentary copy of Energy - Selected Resource Materials for Developing Energy Education/Conservation Programs from: The National Wildlife Federation, 1412 16th Street, NW, Washington, DC 20036.

Good Luck!

Nancy Hack

Greta Smith

Jonathan Wert

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ART ACTIVITY

ENERGY'S DIFFERENT SHAPES

ENERGY IN USE

ENERGY IN THE UNITED STATES

ART ACTIVITY

Title: Energy's Different Shapes

Grade: 4 through 8

Energy Objective: To extend the students' awareness of the various processes and results that different types of energy employ and produce.

Art Objectives:

1. Students will be able to express scientifically defined terms in a creative way.
2. Students will record in sketches or sculptures their concept of a given object which has been taken (by different types of energy) beyond its present existence.

Materials:

1. An object for students to use as a model. The simplicity of the object should parallel the students' artistic abilities.
2. Sketching or painting materials or modeling clay.

Background Information: Energy is a many-faceted concept. So that the term, as a whole, can be understood, investigated and controlled, all of its various aspects much be considered. Included among these aspects are several types of energy, such as mechanical, chemical, electrical, heat, light, gravitational, and nuclear. Usually, the definition and application of these types of energy is purely scientific and technological. By relating the definition to personal experience, a more coherent and even imaginatively extended understanding of the type of work and resultant changes the different types of energy produce may be achieved.

Activities: Before the following activities can be introduced, students must be familiar with the scientific definition and application of mechnaical, electrical, chemical, heat, light, gravitational, and nuclear energy.

Activities:
(Continued)

1. Students choose an object for a model. These models can be as simple as an ice cube, wooden block, rubber ball, or more complex like a mechanical toy, plant, or a chemical mixture.

2. Students should sketch the object in its original state as a basis for comparison.

3. Students then sketch, paint, or sculpt their impression of how the original object changes when the different types of energy are exerted upon it. Students should be encouraged to consider all possibilities in interpreting and expressing their ideas, including reactions at the molecular and atomic levels.

4. The time factor for this assignment can be adjusted by assigning each student only a given number of energy types to interpret and express.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

ART ACTIVITY

Title: Energy in Use

Grade: 4 through 9, preferably grades 4 and 5

Energy Objective: The students will develop an awareness that we use various forms of energy to provide heat, light, and to move things.

Art Objective: The student will be able to make a collage depicting one way we use energy.

Materials: Scissors, paste or glue, old magazines or catalogs, and construction paper.

Background Information: Energy is the ability to do work. We use various forms of energy to do work, to provide warmth, and to move people or things from one place to another. Energy at rest is called potential energy. Energy in action is called kinetic energy. Electrical energy is usually converted into other forms of energy to do work, such as run a can opener or a washing machine. Mechanical energy makes it possible to move machines and other things. The sun's energy is stored up in coal, wood, and oil which people burn to do work for them. This is chemical energy which is converted into heat and light energy.

Activity:

1. Define the terms electrical energy, mechanical energy, and chemical energy.
2. Discuss the three (3) ways energy is used.
3. Make a list of things that (represent) each of the three (3) ways man uses energy.
4. Describe a collage and instruct the students how to make one. (Several examples of collages of various themes might be helpful.)
5. Have the students choose one of the ways we use energy. Have them cut pictures from a magazine or catalog, etc. to represent this use of energy.

Activity:
(Continued)

6. Arrange the pictures on the construction paper and paste.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

ART ACTIVITY

Title: Energy in the United States

Grade: 4 through 9

Energy Objective: To help students develop a better understanding of the energy situation in the United States.

Art Objective: The students will be able to practice skills in drawing, painting, coloring, lettering, design, and formal/informal arrangement.

Materials: Construction paper, oaktag/posterboard, pencils, crayons, paints, magic markers, colored pencils, scissors, and other various art materials and information from Contact Organizations listed on page 2.

Background Information: Because of the oil embargo imposed by the Organization of Petroleum Exporting Countries (OPEC) in 1973, the United States realizes that it has a serious energy problem. Since this time, energy and government officials have been concerned with developing solutions to the problem. One solution for the immediate future is energy conservation and fuel efficiency. Long-range solutions include alternatives to our present sources of energy such as solar, nuclear, geothermal, tidal, etc. Environmentalists are concerned with the pollution that is caused by developing energy resources. There are numerous facets of our energy situation which can be explored. The following activity involves drawing pictures representing several of these facets of energy.

Activity: Students may choose one of the situations listed below and draw a picture depicting that situation.

1. Draw four (4) pictures representing heat being wasted.
2. Draw pictures of several energy consuming appliances in your home.
3. Draw a picture showing stored (potential) energy (e.g. battery, water in a dam, etc.).
4. Draw a picture of a group of people iceskating and how they are keeping warm.

Activity:
(Continued)

5. Draw a picture of your town with gasoline. On the other side, draw a picture of the same town without gasoline.

6. Draw a picture to show all vital areas of a house that should be properly insulated.

7. Design a sign or roadside advertisement which would encourage people to conserve energy. (This could include driving at 55 mph, turning off lights when not in a room, dressing warmly in the winter and keeping the thermostat turned to 68°, etc.)

8. Draw a cartoon depicting energy waste in relationship to transportation.

9. Draw a picture of either of the following: (a) overground power lines crossing a mountain, (b) coal fired steam plant (c) hydroelectric power plant, and (d) a nuclear power plant.

10. Draw a picture of how a shortage of fuel could effect lifestyles. (e.g. line of cars at the gas station).

11. Make a food chain drawing to show animals consuming plants, those animals in turn becoming food for other animals, people eating the animals, etc. (Plants may include clover, corn, wheat, grass, water lily, etc. Animals may include deer, bear, fox, squirrel, grouse, toad, trout, turtle, etc.).

12. Draw a picture of the modes of transportation representative of the past as compared to the future.

13. Students could then show their drawings to the class and have the rest of the students decide what aspect of energy each picture is illustrating.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

MATH ACTIVITY

INSULATION AND R-VALUES

ENERGY CONSUMPTION, GENERATION, AND FUEL RESERVES

READING YOUR ELECTRIC METER

MATH ACTIVITY

Title: Insulation and R-values

Grade: 4 through 9, preferable grades 4 and 5

Energy Objective: The student will have a better understanding of what insulation is and does, the kinds of insulation available, the importance of insulation for comfortable and economical living, and the relationship between insulation and R-values.

Math Objective: The students will be able to practice skills in:

1. reading tables and charts
2. problem solving
3. simple calculations such as addition, subtraction, and multiplication.

Materials: Tables and charts listed below, reference books, and information from Contact Organizations listed on page 3.

Background Information: Insulation is a material that protects against cold, heat, sound, or electricity. Insulation controls these forms of energy by absorbing them or by making it difficult for them to pass through it. House insulation is extremely important not only for comfortable living (keeping out cold or heat) but also economical living. Uninsulated homes leak almost twice as much heat as a properly insulated one. In uninsulated houses the loss of heat is so great that proper insulation in the outside walls and in the ceiling of the top tory will pay for itself in a short period of time in lower fuel bills.

There are many different kinds of insulation used for homes: (1) batt insulation, which comes in small, flexible sections (2) blanket insulation, which comes in rolls of about 100 square feet (3) loose-fill insulation, which is poured or blown into place and is made of glass fiber, rock wool, and cellulosic fiber (4) rigid insulation or thick sheets of fiberboard made in panels and (5) reflective insulation which prevents heat from escaping by reflecting it

Background Information: (Continued)

back into the house. How effective insulation is, is indicated by its R-value. The R-value indicates how much heat or cold the insulation can resist. Therefore, the higher the R-value, the greater the resistance to heat loss and likewise lower fuel bills. In Pennsylvania, ceilings should be insulated to an R-value of 30-33, walls and floors to an R-value of 19.

Activity:

1. Use Table - R-values for Various Thickness of Insulation to answer the following questions:

   A. What would the R-value of 8-9" of glass fiber loose-fill insulation be?

   B. of 10-11" of cellulosic fiber loose-fill insulation?

   C. of 9 1/2-10 1/2" of glass fiber batt or blanket insulation?

   D. of 10 1/2" of rock wool batt or blanket insulation?

   E. Which has a greater R-value and would resist more heat loss-- 10 1/2" of glass fiber batt or blanket insulation or 10 1/2" of rock wool insulation?

   F. Which kind of loose-fill insulation would require the same number of inches of insulation and have the same R-value as 10 1/2" of rock wool batt or blanket insulation?

2. Use Table 2 - Typical R-values for Various Building Materials to answer the following questions:

   A. What would be the R-value of 3 inches of a mineral fiber glass insulation blanket?

   B. of 9" of mineral fiber glass loose-fill insulation?

   C. How much greater is the R-value of 9" of mineral fiber glass loose-fill insulation than 3" of mineral fiber glass blanket insulation?

   D. What would be the total R-value for the outside surface area, one 8" concrete block, 4" of wood fiber blanket insulation, and the inside surface area?

   E. What would the total R-value be if the blanket insulation would be removed?

Activity:
(Continued)

3. The following chart shows the percentage of fuel savings for the number of inches of insulation in each particular area of your home.

Insulation	Savings
3 inches - attic floor	25%
2 inches - exterior wall	8%
2 inches - under lower floor	13%
Every additional inch for the attic floor or outside wall	3%
Additional 3 inches in attic	2%

Use the chart above to answer the following questions?

A. Where would insulation in your home provide the greatest savings? the next greatest savings?

B. If insulation were installed in each part of the home mentioned above, what would be the total savings?

Contact Organizations:

Cooperative Extension Service, The Pennsylvania State University, University Park, PA 16802

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Pennsylvania's Department of Community Affairs, 216 South Office Building, Harrisbrug, PA 17120

Pennsylvania Power and Light Company, Two North Ninth Street, Allentown, PA 18101

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

(Table 1 - (chart) R-Values for Various Thickness of Insulation was aquired from the Governor's Energy Council, Harrisburg, Pennsylvania. Table 2 - Typical R-Values for Various Building Materials was aquired from the Cooperative Extension Service, University Park, Pennsylvania.)

Table 1

R-VALUES FOR VARIOUS THICKNESS OF INSULATION

	BATTS OR BLANKETS		LOOSE FILL (POURED-IN)			
	glass fiber	rock wool	glass fiber	rock wool	cellulosic fiber	
R-11	3½"-4"	3"	5"	4"	3"	R-11
R-13	4"	4½"	6"	4½"	3½"	R-13
R-19	6"-6½"	5¼"	8"-9"	6"-7"	5"	R-19
R-22	6½"	6"	10"	7"-8"	6"	R-22
R-26	8"	8½"	12"	9"	7"-7 "	R-26
R-30	9½"-10½"	9"	13"-14"	10"-11"	8"	R-30
R-33	12"	10"	15"	11"-12"	9"	R-33
R-38	12"-13"	10½"	17"-18"	13"-14"	10"-11"	R-38

Table 2 Typical R Values for Various Building Materials.[1]

Material	R Value Per Inch Thickness	Material	Thickness in Inches	R Value
Building Boards		**Air Space**		
Asbestos-cement board	0.25	Vertical	3/4 to 4	0.95
Gypsum or plaster board	0.85	Vertical	3/4 to 4	2.85 (avg.)
Plywood	1.25	(reflective lining)		
Hardboard	1.53			
Sheathing board (20#/cu.ft.)	2.63	**Air Surface Films**		
		Outside		0.17
Insulating Blankets		Inside		0.68
Mineral fiber glass	3.70			
Wood fiber	4.00	**Masonry Units**		
Hair felt	3.45	Concrete blocks	4	0.71
		Concrete blocks	8	1.11
Boards and Slabs		Same core filled	8	1.93
Cellular glass	2.50	Concrete blocks	12	1.28
Polystyrene, extruded, plain	4.00			
Polystyrene, freon expanded	5.00	Cinder aggregate	4	1.11
Polystyrene, molded beads	3.57	Cinder aggregate	8	1.72
Polyurethane (R-11 Exp)	6.25	Cinder aggregate	12	1.89
		Light weight aggregate (24 lbs.)	8	2.00
Loose Fills		Light weight		
Mineral fiber glass	3.57	aggregate (filled)	8	5.03
Sawdust, shavings	2.22	Light weight		
Vermiculite (expanded)	2.27	aggregate (38 lbs.)	12	2.48
Perlite (expanded)	2.70	Light weight		
Cellulose insulation	3.70	aggregate (filled)	12	5.82
Masonry		**Roofing**		
Cement mortar	0.20	Asphalt shingles	1/4	0.44
Regular concrete	0.08	Built-up roofing	3/8	0.33
Cement plaster	0.20	Asphalt roll roofing 70#/ft^3		0.15
Woods				
Hardwoods	0.91			
Softwoods	1.25	**Siding**		
		Wood, dbl 12" exposed		1.19
Windows[2]		Wood, bevel 3/4 x 10" lapped		0.95
Single pane	0.94			
Double pane (air space)	1.64			
Single pane (with storm sash)	1.54(avg.)			

[1] Information adapted from ASHRAE Handbook of Fundamentals 1972.

[2] Total resistance including air films.

MATH ACTIVITY

Title: Energy Consumption, Generation, and Fuel Reserves

Grade: 5 and 6

Energy Objective: To help the student develop an awareness of the following aspects of the energy situation:

(a) The percentage of different energy sources consumed in the United States and Pennsylvania.
(b) The percentage of each sectors' consumption of energy in the United States and Pennsylvania.
(c) The percentage of different energy sources for electrical generation in Pennsylvania.
(d) The percentage of different known fuel reserves in the United States.
(e) The survival expectations of energy sources if present rates of consumption are maintained.

Math Objective: The child will be able to construct pie charts and bar graphs representing the percentage and time factors given.

Background Information:

- In 1975, Pennsylvania's electrical generation was as follows:

Coal	77%
Nuclear	15%
Petroleum	7%
Hydro	1%

- Known fuel reserves in the United States are as follows:

Coal	90%
Gas	4%
Oil	3%
Nuclear	3%

Background Information: (Continued)

- The following information gives the percentages of energy the United States consumed by sector in 1975:

Industrial	47%
Transportation	25%
Residential	17%
Commercial	9%
Governmental	2%

- In terms of fuels and present use, the United States has enough:

GAS to last 14 years

PETROLEUM to last 15 years

GEOTHERMAL to last 50 years

OIL SHALE to last 80 years

COAL to last 200 years

NUCLEAR to last 25 years without Breeder Reactor
2,000 years with Breeder Reactor

SOLAR (unlimited)

- The following table shows Energy Consumption in the United States and Pennsylvania in 1975:

	U.S.	PENNSYLVANIA
Petroleum	46%	34%
Natural Gas	29%	17%
Coal	19%	45%
Hydro & Geothermal	4%	0%
Nuclear	2%	4%

Activities: Students can either be presented with the background information or do research to acquire the facts and figures for themselves. The following series of

Activities: (Continued)

activities can be used to introduce, reinforce, or evaluate the specified graphing and charting skills.

(1) a. Instruct students in the principles and techniques of pie charts by guiding them in the construction of a pie chart which represents Pennsylvania's electrical generation in 1975.

b. As reinforcement or evaluation, students will construct a pie chart representing the known fuel reserves in the United States.

(2) a. Instruct students in the principles and techniques of bar graphs by guiding them in the construction of a bar graph which represents United States' consumption of energy by sector.

b. As reinforcement or evaluation, students will construct a bar graph representing the survival expectations for United States energy sources.

(3) Students will construct a double bar graph which compares Pennsylvania's and United State's consumption of various energy sources.

Extending Activities:

The following activities can be used to extend the graphing activity into other subject areas or to higher grade levels.

1. Using the double bar graph for ACTIVITY 3 and additional geographic research, answer the following questions:
   -- Why is Pennsylvania's coal consumption so much higher than the national percentage?
   -- Based upon the findings for the previous question, which other states might you expect to also have a high percentage of coal consumption? (Support your answers with facts from your research.)

2. The following activity is based upon the graph constructed in ACTIVITY 2a. Decide which consumption sector should be the primary point of concentration for an energy conservation program. Find out what types of conservation programs have been proposed for or are employed by the various sectors. What governmental restrictions concerning energy conservation exist for each sector?

Extending Activities: (Continued)

3. Students are presented with the following situation:

> If you were the president of an electircal power plant which used coal as a fuel, and you knew that Pennsylvania's coal reserves would be depleted within ten (10) years, what would you choose as an alternative power source?

Students should be instructed to give economic, geographic, ecological, scientific, and conservational reasons for their choices.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

MATH ACTIVITY

Title: Reading Your Electric Meter

Grade: 5 and 6

Energy Objectives: To help students gain an understanding of how electrical energy is measured.

Math Objectives: The child will be able to read an electric meter, determine how many kilowatt hours of electricity are used over a certain period of time, calculate the cost of the use of the electricity at various rates, and find the cost of electricity over a six month period of time.

Materials: Meter Reading Worksheet, pamphlets from local electric companies, books on related topic, and old electric bills.

Background Information: Your electric meter is an accurate automatic measuring instrument which keeps track of how much electrical current flows into your home. Most electric meters have a series of four or five dials on which a needle points to the number of kilowatt-hours of electricity you have used since the meter was installed. On most electric meters the dials are organized from right to left: the right-most dial indicating kilowatt hours, the next dial tens of kilowatt hours, the next dial hundreds of kilowatt hours, etc. The dials are read from left to right. (Every other dial reads counter-clockwise.) On each dial, read the lowest number to which the needle is pointing. When the pointer seems to be directly on a number, look at the dial to the right. If the pointer on the right side dial has passed "0", then write down the number the pointer seems to be on. If the pointer on the right side dial has not passed "0", then write down the previous lower number on the dial you are recording.

Background Information: (Continued)

Study the meter below and fill in the blanks beneath each dial. This will be your meter reading.

3 7 5 0 6 = 37506

Kilowatt Hours:

Each month a man from your local power company is sent to your home to read your electric meter. His job is to read the meter and determine how much electricity was used during the one month period. He does this by subtracting the reading from the previous month from the current reading.

Activity:

1. Read the six electric meters on the Meter Reading Worksheet. Record the number of kilowatt hours.

2. Calculate how many kilowatt hours of electricity were used during each one month interval.

3. If the cost of electricity per kilowatt hour is $0.023, how much would your electric bill be for each month? If the rate is $0.034? $0.04?

4. Find the average cost of electricity for the six month period if the reading for July 15 was 43550 kilowatt hours.

Evaluation: Can the students accurately read an electric meter? Are the students able to calculate the cost of electricity at various rates? (The worksheet could be used as an evaluation.)

Additional Follow-Up Activities:

1. Note which months the bills were the highest. Why might the bills be higher during this time of the year?

   (Possible answers)
   A. less daylight hours
   B. spend more time indoors for recreation, such as watching television, etc.
   C. home is heated by electricity

Additional Follow-Up Activities: (Continued)

2. Divide the class into groups of two. Compare light bills. Why might one be higher or lower than another?

(Possible answers)
A. home is larger
B. more family members
C. more electrical appliances
D. one family is more "energy conscious"
E. electricity is heating one home and not another
F. electric as compared to oil hot water heater
G. electric as compared to gas stove, etc.

3. What could be done to lower the cost of electricity in your home?

A. Read your meter and record the reading along with the date you read the meter.
B. Read it again a week or two later.
C. During this time, encourage family members to conserve electricity as much as possible. List steps to conserve energy.
D. Note any change. Were you successful? If not, why?

Contact Organizations:

Contact your local electric utility. The address and telephone number are usually found on old utility bills. You can also obtain the name and address of the utility serving your region from the yellow pages in the telephone directory or by writing to the Pennsylvania Electric Association, 301 APC Building, 800 North Third Street, Harrisburg, PA 17102.

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Public Utilities Commission, 104 North Office Building, Harrisburg, PA 17120

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

METER READING WORKSHEET

Reading 1 - January 15

Kilowatt hours: _____

Reading 2 - February 15

Kilowatt hours: _____

Reading 3 - March 15

Kilowatt hours: _____

Reading 4 - April 15

Kilowatt hours: _____

Reading 5 - May 15

Kilowatt hours: _____

Reading 6 - June 15

Kilowatt hours: _____

SCIENCE ACTIVITY

ENERGY VOCABULARY

ENERGY FLOW IN PRODUCING ELECTRICITY

NUCLEAR ENERGY VOCABULARY

COAL AND PETROLEUM VOCABULARY

SCIENCE ACTIVITY

Title: Energy Vocabulary

Grade: 4 through 9

Energy & Science Objective: Students develop definitions for key energy terms and measurements.

Materials: Content related references and textbooks. Request listings of energy terms and definitions from the Contact Organizations given on page 2.

Background Information: Before students will be able to understand much of the literature on energy, they will need to become familiar with several key energy terms and measurements. A few of these terms are included in the following lists:

I.
- potential energy
- kinetic energy
- nonrenewable resources
- efficiency
- thermodynamics (2 laws)

II.
- solar energy
- geothermal energy
- ocean thermal energy
- wind power
- tidal power
- bioconversion
- hydropower

III.
- ampere
- volt
- watt
- cord
- barrel
- therm
- R-value
- millirem

Activities: Students use the terms and measures given in the Background Information above to begin their own personal word lists. The list can be expanded on a continuing basis and a copy kept for future reference. This expanding energy word list can be done as a team project.

Group I: Students develop definitions, supplying examples and illustrations when possible.

Group II: Students describe the dynamics of each type of energy source in addition to listing current and prospective uses. Existing operations which

Activities:
(Continued)

utilize the energy source should also be cited and located.

Group III: Students describe each unit of measurement, the factor it is used to measure, and related symbols. A conversion table showing the correlation between British Thermal Units, kilowatt hours, kilocalories, and another relating horse power, kilowatts, and foot-pounds per second (all measures of power) should also be included.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

National Science Teachers Association (NSTA), 1742 Connecticut Avenue, NW, Washington, DC 20009

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

SCIENCE ACTIVITY

Title: Energy Flow in Producing Electricity

Grade: 5 and 6

Energy Objective: Students will be made aware of the energy transfers which take place when electricity is produced and the amount of energy lost as a result of these transfers.

Science Objective:

1. Students will trace and record the energy flow and subsequent energy transfers in producing electricity.

2. Students will research and record findings concerning the nature and amount of efficiency, lost energy, and waste materials of several types of electricity-producing power plants.

Materials: Encyclopedias; text-books and other content-related reference books; contact sources; materials needed for chart (see Activities)

Background Information: The efficiency of a power plant is determined by the amount of heat used to generate one kilowatt of electricity. However, because of high temperature and pressure levels, the heat produced is not forceful enough to be 100% efficient. In fact, no type of contemporary power plant can produce at an efficiency level higher than 50%. Even developers of the proposed nuclear breeder reactor predict no more than 45% efficiency. The unused or rejected heat is removed from the plant by a coolant - usually circulating water or gas - to the surrounding air or water - all of this heat, WASTED ENERGY.

Activities:

1. Introduce "Energy Transfer Chart" (see Figure A). This chart can be done on a bulletin board, on large chart paper, or on a blackboard.

Activities: (Continued)

2. Assign groups to do the research to complete the charts. The number of groups is determined by the number of power plants being researched. The following possibilities may be considered:

- hydroelectric	-solar
-fossil fuel	-geothermal
-nuclear	-others

Different types of fossil fuel or nuclear plants can be individually researched.

3. The information can be filled in on the chart as the students acquire it or as a whole-class culminating activity.

4. If the student's findings are removable, the chart itself or a mimeographed copy can be used to evaluate the students' acquisition and understanding of the information.

Additional Follow-Up Activities:

1. Students can discuss, debate, or prepare a written report on the positive and negative aspects (efficiency vs. waste) of the various power plants.

2. Students can do durther research and reporting to reveal what happens to energy and material excesses. (Suggested topics include thermal pollution, nuclear wastes, and chemical pollutants.)

Contact Organizations:

Contact your local electric utility. The address and telephone number are usually found on old utility bills. You can also obtain the names and addresses of the utility serving your region from the yellow pages in the telephone directory or by writing to the Pennsylvania Electric Association, 301 APC Building, 800 North Third Street, Harrisburg, PA 17102

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Environmental Protection Agency, Waterside Mall, 401 "M" Street, SW, Washington, DC 20460

TYPE OF PLANT	ENERGY TRANSFORMATIONS	EFFICIENCY	HEAT LOSS	MATERIAL WASTES
1. Hydroelectric				
2. Fossil Fuels				
3. Nuclear	example: nuclear--heat--electrical	33-40%	60-67%	radioactive wastes -usable -unusable plutonium contaminated equ.
4. Solar				
5. Geothermal				
6. Others				

SCIENCE ACTIVITY

Title: Nuclear Energy Vocabulary

Grade: 5 and 6

Energy Objective: To guide students in defining terms related to nuclear energy and discover how these terms are related to energy conservation. The terms to be presented are fission, fusion, light water reactor, fast breeder reactor, and radioactivity.

Science Objective:

1. Students will devise technical, scientific definitions for terms related to nuclear energy by researching to answer developmental questions about the terms.

2. Students will establish relationships among the nuclear energy terms by synthesizing their research to answer final evaluation questions.

Materials: Encyclopedias, text-books and other content-related reference books, and contact organizations.

Background Information: Most science text-books present a basically technological definition of nuclear energy. Therefore, the relationship between the power source and economics, environment, and conservation must be derived from other sources. The remainder of this background information defines the terms not only in their role in energy production, but also in relation to other relevant factors.

Nuclear energy is so named because the nucleus of an atom is the generator of the energy. The two processes, fission (splitting of a nucleus) and fusion (combining of nuclei) give off heat energy necessary to operate a steam turbine in an electrical power plant. The fusion process has the advantages of an inexhausible fuel supply (fusion uses a form of heavy hydrogen which is found naturally in water, while the scarce element uranium is the fuel for the fissions process); less radioactive waste; higher

Background Information: (Continued)

energy efficiency because of less heat loss; and the need for fewer safety precautions. However, although the fusion process has been developed, its adaptation to large-scale, profitable energy production has not been achieved. Scientists and engineers are working to develop materials and processes which can contain and concentrate higher temperature levels so that the output energy of a fusion plant equals or exceeds the input. Until these advancements are achieved, fission reactors remain the source of energy in the United States.

The fission of uranium nuclei is the process employed in the light water reactors which are responsible for nuclear-generated electricity in the United States today. The fast breeder reactor also produces energy through the fission process, but differs from the light water reactor in the following ways:

1. The breeder reactor uses a mixture of uranium and plutonium for fuel. This fuel mixture reacts to produce more fissionable material after the process is initiated.

2. The breeder is cooled with liquid sodium instead of water.

3. While light water reactors slow the speed of the bombarding neutrons, breeder reactors do not impede the speed of the neutrons.

These differences were developed to increase efficiency, conserve fuel, and reduce the escape of radiation in nuclear-electrical generation. However, other safety and ecological factors have hampered the development of the breeder reactors in the United States.

Radioactivity is the energy, either in the form of particles or rays, given off by the disintegration of atomic nuclei. This radiant energy can cause a deterioration of health (especially noted as a cause of cancer), a shortened life span, or genetic damage which can be passed on to offspring. However, medical authorities contend that exposure levels would have to exceed the 130 mrem. per year average exposure rate to have any effect on an individual's present or future health status. Man's exposure to radiation is from several sources: (1) natural background radiation, (2) medical x-rays, (3) fallout from weapons' tests, and (4) nuclear power plants. Of

Background Information: (Continued)

these four major sources, nuclear power plants account for only .044 per cent of the total exposure. This low level of exposure is due to the safety precautions required, not only in the nuclear processes, but also in the disposal of waste materials. Contaminated equipment is sealed in specially designed containers and transported to designated disposal areas. Both gaseous and liquid wastes must be stored to allow decay of their radioactivity level, diluted, and only then released. Solid radioactive wastes are buried in natural salt beds and other isolated geological formations.

The activities which follow use technological information as the foundation in building an awareness of nuclear energy as it affects and is affected by economic, environmental, and conservational factors.

Activities:

1. Each of the following sets of questions can be assigned to individual students or to designated groups.

2. Students then use suggested sources to answer the questions.

3. Student findings are shared and discussed before the evaluation questions are assigned.

4. After discussing the findings for the developmental questions, each evaluation question should be answered by a short essay.

DEVELOPMENTAL QUESTIONS

Fission and Fusion

1. Why are fission and fusion called "nuclear" reactions?
2. What happens to an atom's nucleus in fission?
3. What happens to an atom's nucleus in fusion?
4. Why is uranium used in fission processes?
5. Why is hydrogen used in fusion processes?
6. Why do existing nuclear power plants employ the fission process?
7. What advantages does the fusion process have over the fission process?

Activities: (Continued)

Light Water Reactors and Fast Breeder Reactors

1. In a nuclear reactor, how can a nuclear reaction turn a steam turbine?
2. What type of fuel does a breeder reactor use?
3. What does a breeder reactor use as a coolant?
4. Why are breeder reactors called "energy conserving" power plants?

Radioactivity

1. What is radioactivity?
2. What happens to the radioactive waste from nuclear power plants?
3. What harmful effects does radiation have on the human body?
4. How much radiation is an average person (one not in nuclear work) exposed to in one year?
5. What are other sources of radiation besides nuclear power plants?

EVALUATION QUESTIONS

Fission and Fusion: If the process of producing nuclear energy through fusion is so difficult and costly, why do scientists and engineers continue their research?

Nuclear Reactors: What would be the advantages to developing breeder reactors to produce nuclear energy?

Radioactivity: Will the normal operation of nuclear power plants cause a substantial increase in the occurrence of cancer or radioactivity-related deaths? Explain your answer.

Contact Organizations:

American Nuclear Society, 244 East Ogden Avenue, Hinsdale, IL 60521

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Department of Health, Education, and Welfare, 330 Independence Avenue, SW, Washington, DC 20201

SCIENCE ACTIVITY

Title: Coal and Petroleum Vocabulary

Grade: 5 and 6

Energy Objective: Students will define the following energy terms related to coal and petroleum: bituminous coal, anthracite coal, lignite, coal gasification, coal liquification, propane, fuel oil, kerosene, methane, and liquified natural gas.

Science Objective: Student will establish an understanding of each term's place in the energy conservation picture.

Materials: Encyclopedias, text-books and other content-related reference books, and Contact Organizations.

Background Information: Although the objective of a vocabulary activity is to technically define a given term, the primary stress in this particular vocabulary activity is to use the technical definition of the energy terms to understand the role each material and process plays in the energy conservation picture. For example, because of anthracite coal's higher concentration of carbon, it is a more efficient energy producer than bituminous or lignite coal. However, anthracite is not as abundant or as easily mined as other forms of coal, reducing its desirability as an energy source. Going beyond the technical chemical explanation of coal gasification and liquification, the use of the liquid and gaseous products of these two processes as a more easily transportable, less polluting and more versatile coal fuel should be emphasized.

This method of applied research can also be stressed in defining terms associated with petroleum. The chemical composition and fuel quality of the various products which result from the refinement of crude oil should be defined. These definitions should then be used to facilitate an evaluation of current and prospective uses of each by-product in terms of efficiency in energy production. After technically defining liquified natural gas, the positive effects

(alleviation of the gas shortage) and the negative effects (foreign dependency) should both be considered and evaluated. This technique of extending definitions beyond a technical explanation will enable a student to acquire an applied, more useful understanding instead of a purely scientific one.

Activities:

1. Students research to find one scientific characteristic, one energy advantage, and one energy disadvantage for the processes and material given.

2. A class sharing and discussion session should follow the completion of the research. During this session, a list of all findings should be made for each term.

Contact Organizations:

American Petroleum Institute, 1801 "K" Street, NW, Washington, DC 20006

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

National Coal Association, 1130 Seventeenth Street, NW, Washington, DC 20036

Pennsylvania Coal Association, 240 North Third Street, Harrisburg, PA 17101

Pennsylvania Petroleum Association, 2101 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

SOCIAL STUDIES ACTIVITY

ENERGY RESOURCES, SUPPLY AND DEMAND

TRANSPORTATION AND ENERGY WASTE

THE TRANSALASKA PIPELINE

SOCIAL STUDIES ACTIVITY

Title: Energy Resources Supply and Demand

Grade: 4 through 9, primarily grade 6

Energy Objective: To help students develop an understanding of the rapid depletion of our main energy resources (coal, oil, and natural gas) and the economic impact this has upon the consumer.

Social Studies Objective: The student will be able to:

a. define the terms supply and demand
b. understand how the supply and the demand for a product effects the price at which it can be sold
c. use the principle of the Law of Supply and Demand to predict future costs of oil, coal, and natural gas if the demand for these products continues to exceed their supply

Materials: Supply and Demand Concept Sheet, Supply and Demand Worksheet, reference books, books on related topic, information from Contact Organizations listed on page 2.

Background Information: Since the early 1900's, the consumption of the energy resources coal, oil, and natural gas (nonrenewable) has almost doubled every twenty years. Because of this, our fossil fuel reserves are depleting rapidly. These fossil fuels took millions of years to develop, yet we continue to consume them at a faster and faster rate. Some of our known energy supplies seem to be in danger of being exhausted within the next 10-20 years and only after 100 years of use! Consequently, our energy demand (the total quantity of usable energy man wants or needs) has been greatly exceeding our energy supply or the total quantity of usable energy available to man. Therefore, the cost of consumption has continued to increase.

Activity:

1. Define the terms supply and demand.
2. Use the Law of Supply and Demand Concept Sheet to develop the understanding of how supply and

Activity:
(Continued)

demand for a product effects the price of it.

3. List our main energy resources in order of importance. Discuss with the students the rapid depletion of these energy sources in comparison to the demand for them.

4. Have students complete Supply and Demand Worksheet.

5. Lead the students to draw the conclusion that as long as our main energy sources continue to dwindle and the demand for the resources continues to increase, the cost of the products will also continue to increase.

Additional Follow-Up Activities:

1. Make a list of all possible factors which could cause or is causing such rapid consumption of our energy supplies.

(Possible answers)

A. population increase
B. growth of a labor force
C. increased wealth among the population
D. energy-using inventions
E. production of goods which require large amounts of energy to manufacture

2. List alternatives for this problem for the future.

A. Development of new energy sources.

B. Improve efficiency of existing fuels.

C. Energy conservation programs.

Contact Organizations:

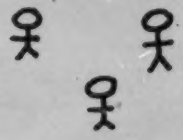
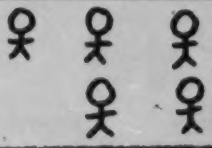
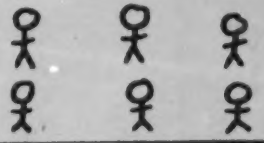
Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

Law of Supply and Demand
(Concept Sheet)

****

This chart shows changes in the supply, demand, and price of lollypops. By looking at the following examples, you will understand how supply and demand effect the price of a product.

	SUPPLY	DEMAND	PRICE
NORMAL...			20¢
1			30¢
2			15¢
3			40¢
4			17¢

A. If the supply of lollypops stays the same, but the demand for the product increases, the price will go up a moderate amount.

B. If the supply of lollypops stays the same, but the demand for them decreases, the price also decreases.

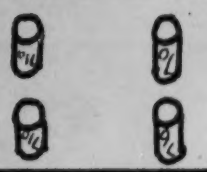
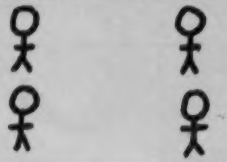
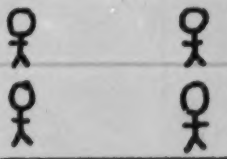
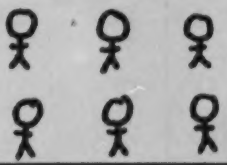
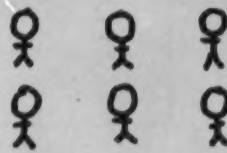
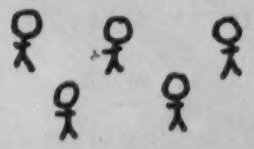
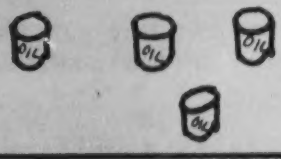
C. If the supply of lollypops decreases buy the demand increases, the price of the lollypops will increase greatly.

D. If the supply of lollypops increases and the demand for them stays the same, the price will decrease moderately.

Law of Supply and Demand
(Worksheet)

****

Directions: Look at each situation below. Decide whether the price of oil in each case would increase or decrease. If you decide it would increase, indicate this as ↑. If it would decrease, use this symbol - ↓ . If it would stay the same, use the initials S.T.S.

Supply (1 billion =barrels)	DEMAND (1 billion =people)	PRICE
NORMAL 		$20
		
		
		
		
		

SOCIAL STUDIES ACTIVITY

Title: Transportation and Energy Waste

Grade: 4 through 7

Energy Objectives: To help students develop a better understanding of the energy waste associated with the transportation of people and goods and the opportunities for individuals to reduce this energy waste.

Social Studies Objective: The students will be able to list major causes of energy waste in transportation and the ways to reduce this waste, list the advantages and disadvantages of various modes of transportation, and the advantages and disadvantages of the alternatives to individual transportation such as carpooling.

Materials: Transportation Chart (attached), information collected from Contact Organizations listed on page

Background Information: Of the total amount of energy consumed in the United States, over 25% of it is used for transportation. However, on an individual basis, the total amount of energy used for transportation accounts for nearly 50% of it! Therefore, it is obvious that there is great potential for individuals to save energy in the transportation sector.

Activity:

1. What are the major ways energy is wasted by the transportation sector? List them.
2. What are the most effective means to conserve energy that is wasted in the transportation of people and goods? List them.
3. What are the major advantages and disadvantages of various modes of transportation? Complete the Transportation Chart provided. (Note safety, energy use, its cost, efficiency (number of passengers), pollution of the air, etc.
4. Why are trucks being used more to transport goods than railroads?

5. What are the advantages and disadvantages of the alternatives to individual transportation such as carpooling, vanpooling, or buspooling?

   Students should:

   A. Make a comprehensive listing of the ways the family uses transportation.

   B. Keep a record of the times and the number of ways the family car is used for a week's period of time.

   C. Develop a plan for how they will get from one place to another if gasoline becomes scarce and expensive. (Include things such as carpooling, consolidating trips, planning the most direct and efficient route, schedule trips to avoid rush hours, etc.)

   D. Prepare a list which indicates the transportation needs they could do without. (The list should be prioritized).

Follow-up Activities:

1. How would the lack of personal mobility effect the lives of senior citizens? (i.e. shopping, obtaining medical services, groceries, recreation, etc.)

2. Prepare a report (oral/written) on how your social life would change if personal/family mobility was

Contact Organizations:

American Petroleum Institute, 1801 "K" Street, NW, Washington, DC 20006

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Pennsylvania Department of Environmental Resources, Evangelical Press Building, Box 1467, Harrisburg, PA 17120

Pennsylvania Department of Transportation, 1200 Transportation and Safety Building, Harrisburg, PA 17120

Pennsylvania Petroleum Association, 2101 North Front Street, Harrisburg, PA 17102

Contact Organizations: (Continued)

Transportation Institute, The Pennsylvania State University, 114-F Research Building, University Park, PA 16802

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Department of Transportation, 400 Seventh Street, SW, Washington, DC 20590

U.S. Environmental Protection Agency, Waterside Mall, 401 "M" Street, SW, Washington, DC 20460

NOTE: Include safety, energy use, its cost efficiency (number of passengers), pollution of the air, etc.

Transportation Chart

Mode of Transportation	Advantages	Disadvantages
Automobile		
Truck		
Bus		
Mass Transit		
Railroad		
Airplane		
Bicycle		
Ship		
Walking		

SOCIAL STUDIES ACTIVITY

Title: The TransAlaska Pipeline

Grade: 4 through 9, primarily 4, 5, and 6

Energy Objective: To help the students develop an awareness of America's dependence on foreign petroleum imports and to understand that the construction of the TransAlaska Pipeline was a step toward limiting that dependence.

Social Studies Objective: The child will be able to:

a. Understand the purpose of the construction of the TransAlaska Pipline.

b. Locate Alaska on a map of North America and trace the route of the Pipeline.

c. List important facets of the Pipeline.

d. Determine whether the United States achieved its purpose through the construction of the Pipeline.

Materials: Map of North America and Alaska, reference books, pamphlets from Contact Organizations listed on page 3, and books on related topic.

Background Information: The single most important source of energy for the United States is oil. We are bigger consumers of oil than we are producers. Since the 1970's the United States has been importing more and more petroleum. After World War II, the United States only imported approximately 8% of the total quantity of oil consumed. But by 1967, the total quantity of oil imported reached a new high of 20% and by 1976 it totaled 42%. This increasing rise in the importation of oil has been of major concern for the U.S. One concern was the Organization of Petroleum Exporting Countries (OPEC) creating an oil embargo in 1973. This embargo denied oil producers of OPEC from selling oil to oil consuming countries such as the United States. Therefore, prices of petroleum skyrocketed. Another concern for the U.S. is that OPEC countries will use petroleum to win political concessions. Also, any oil embargo would

Background Information: cause severe damage on the economy. Because of this the United States has been trying to become less dependent upon foreign imports.

One way to limit that dependence upon foreign imports is to produce more oil in the U.S. Around 1968, vast quantities of petroleum were found in Alaska, primarily near Prudhoe Bay in the Arctic Coastal Plain area. Shortly afterwards, plans to construct a pipeline were announced - the TransAlaska Pipeline.

Activity:

1. Discuss with students how much America depends on foreigh petroleum imports.
2. What was the purpose of the construction of the TransAlaska Pipeline?
3. Locate Alaska on a map of North America. Trace the route of the Pipeline.
   a. Where does the Pipeline begin? End?
   b. What three major mountain ranges does it cross?
   c. How many rivers and streams does it cross?
   d. How many miles long is the Pipeline?
4. Why was the TransAlaska Pipeline one of the most difficult U.S. projects?
5. Scientists and engineers had to undergo five years of testing and studying before the United States could begin construction of the Pipeline. What were these scientists and engineers studying and testing?
6. After construction of the Pipeline began, it was delayed for five years. Why?
7. Most pipelines are underground but more than 50% of the TransAlaska Pipeline is elevated. Why?
8. What is the purpose of the pumping stations?
9. What safety features are provided for the Pipeline?
10. Has the United States achieved its goal with the construction of the Pipeline?

Culminating Activities:

1. Note the number of jobs that construction of the Pipeline provided for people in the United States.

2. Arrange for a local person who worked on the Trans-Alaska Pipeline to give a class presentation.

Contact Organizations:

Alyeska Pipeline Service Company, 1835 South Bragaw Street, Anchorage, AK 99504

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Environmental Protection Agency, Waterside Mall, 401 "M" Street, SW, Washington, DC 20460

LANGUAGE ARTS ACTIVITY

NONRENEWABLE RESOURCES RESEARCH REPORTS

SOLAR ENERGY DEBATE

ENERGY EDUCATION RESOURCE GUIDE FOR PENNSYLVANIANS

LANGUAGE ARTS ACTIVITY

Title: Nonrenewable Resources Research Reports

Grade: 4, 5, and 6

Energy Objective: To help students develop an understanding of three of our most widely used and valuable nonrenewable resources - coal, oil, and natural gas.

Reading Objective: The student will be able to practice skills in library research and report writing.

Materials: Encyclopedias, books on related topics, and booklets and pamphlets from contact organizations listed on page 3.

Background Information: Energy resources in limited supply are referred to as nonrenewable energy resources. Fossil fuels such as coal, oil, and natural gas are nonrenewable because they developed from fossil remains of prehistoric plants and animals which were under great pressure in the earth's crust for over millions of years. The earth only has a limited supply because people burn these fuels faster then they form. Once these fuels are consumed, they are therefore practically impossible to replace. Consequently, the conservation of these energy resources is vital.

Activity:

1. Establish guidelines or a format for the students when writing their reports. Use the following suggestions when establishing these guidelines.

   A. The teacher should specify the number of sources the child is required to utilize before beginning his report. (Example: one encyclopedia source and one book source.)

   B. The teacher should review the process of notetaking.

Activity:
(Continued)

C. Establish the form the report should take, such as:
   (1) outline form
   (2) paragraph form
   (3) chart or graph presentations

D. Specify how long the report should be.

E. The teacher should also review research skills such as:
   (1) library orientation
   (2) use of the card catalog
   (3) use of encyclopedias
      a) indexing
      b) cross-referencing

2. Have the students choose a topic on one aspect of a nonrenewable energy resource, research the topic and complete a report on it.

   The following topics may be considered:

   COAL

   - How is coal formed?
   - Where are coal reserves found in Pennsylvania?
   - Where are coal reserves found in the nation?
   - What are the kinds of coal?
   - How is coal mined?
   - How is coal transported?
   - What are some of the major products made from coal?
   - What are some of the major coal mining safety measures?
   - How can coal be conserved more effectively?
   - Why is coal important?
   - What is coal gasification?
   - What are the environmental advantages and disadvantages of using coal?

   OIL

   - How is petroleum formed?
   - Where are the major oil reserves in Pennsylvania? In the nation?
   - What are some of the major uses of petroleum?
   - What are the methods used in drilling for oil?
   - How is oil refined?
   - What career opportunities are available in relation to the oil industry?
   - What are the major United States oil companies?

Activity:
(Continued)

OIL (Continued)

- What are the environmental advantages and disadvantages of using oil?
- What are the most important ways to conserve oil?

NATURAL GAS

- How is natural gas formed?
- Where are the major natural gas deposits or reserves in Pennsylvania?
- In the United States?
- How is natural gas stored and transported?
- What are some of the major uses of natural gas?
- How can natural gas be conserved more effectively?
- What is the Public Utilities Commission's (PUC) role in regulating natural gas in Pennsylvania?
- What are the environmental advantages and disadvantages of using natural gas?

Contact Organizations:

American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209

American Petroleum Institute, 1801 "K" Street, NW, Washington, DC 20006

Federal Power Commission, 825 North Capitol Street, NE, Washington, DC 20426

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

National Coal Association, 1130 Seventeenth Street, NW, Washington, DC 20036

Pennsylvania Coal Association, 240 North Third Street, Harrisburg, PA 17101

Pennsylvania Gas Association, State Street Building, Harrisburg, PA 17101

Pennsylvania Petroleum Association, 2101 North Front Street, Harrisburg, PA 17102

Public Utilities Commission, 104 North Office Building, Harrisburg, PA 17120

Contact Organizations: (Continued)

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Department of the Interior, Information Office, 18th and "C" Street, NW, Washington, DC 20240

LANGUAGE ARTS ACTIVITY

Title: Solar Energy Debate

Grade: 6 through 9

Energy Objective: Students will be exposed to the advantages and disadvantages of solar energy and its use as an alternative to present energy sources.

Language Arts Objective:

1. Students will use and develop research skills involving reference books and correspondence.
2. Students will organize and synthesize research findings to provide objective support for their argument.
3. Students will use organized research in a debate.

Materials: Encyclopedias, other content-related reference and text books and Contact Organizations.

Background Information: The use of solar energy to supplement the nation's energy and power generating systems is ever becoming a more present reality. Many Pennsylvania's have begun to use solar energy systems for domestic water heating, swimming pool heating, and space heating and cooling. Attention to this alternative form of energy has been stimulated by the rising costs of fuels, electricity concerns over air and water pollution, and health and safety problems associated with nuclear power. The supporters of solar energy are quick to point out that it is (1) a virtually inexhaustible resource; (2) a source which cannot be monopolized by one nation or company; (3) not expected to introduce major environmental impacts; (4) a means to air in the conservation of fuels, particularly oil and gas; and (5) once installed, inexpensive to maintain. However, there are also several disadvantages in using solar energy as an alternative energy source. These negative features include: (1) expensive installation; (2) the great amount of space needed, especially if used in electrical generation; (3) inconsistency of the presence and amount of sunlight on different days or during an entire season; and (4) the expense involved in modifying present buildings when adapting to solar systems.

Activity: Before beginning this activity, students should have a basic understanding of related vocabulary and the functioning of solar energy systems.

1. Students are divided into two groups, one pro-solar energy and one anti-solar energy.

2. Each group should designate three sub-committees:

   (a) researchers (find information)
   (b) organizers (put information together to create a logical argument).
   (c) debators (present argument)

   Each committee will then perform its duties in turn. In so doing, each committee will have been exposed to the given material. Through the debate, all students will be exposed to both arguments.

3. The following questions provide direction for possible research:

   - How much would a good solar energy system cost for a single family dwelling?
   - Are there any tax advantages to those installing solar energy systems?
   - Will solar heating really work in Pennsylvania?
   - What types of modifications would have to be made to install solar systems in existing buildings?
   - What happens when there is not enough sunlight for a solar system to operate adequately?
   - Is solar-electrical generation economically practical? Explain why or why not. Explain any geographical limitations.

Contact Organizations:

American Section of the International Solar Energy Society, 330 State Road 441, Cape Canaveral, FL 32970

Environmental Action Reprint Service, 2239 East Colfax, Denver, CO 80206

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

National Intervenors (The), 153 "E" Street, SE, Washington, DC 20003

National Solar Heating and Cooling Information Center, P.O. Box 1607, Rockville, MD 20850

Contact Organizations: (Continued)

National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161

Solar Energy Industries Association, Incorporated, Suite 632, 1001 Connecticut Avenue, NW, Washington, DC 20036

Solar Energy Research Institute, 1536 Cole Boulevard, Golden, CO 80401

Solar Energy Services, P.O. Box 2166, Hendersonville, NC 28739

U.S. Department of Energy, Division of Solar Technology, Washington, DC 20545

U.S. Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830

LANGAUAGE ARTS ACTIVITY

Title: Energy Education Resource Guide for Pennsylvanians

Grade: 4 through 9

Energy Objective: To help the students develop an understanding of:

a. the various state and federal organizations and private industries involved in energy education and conservation.

b. the organizations' and industries' respective roles in energy education and conservation.

c. how to prepare a publication describing resources available to Pennsylvania citizens.

Language Arts Objective: The students will be able to practice skills in research writing, letter writing, outlining, alphabetizing, language usage skills, notetaking, and verbal communication.

Materials: Descriptions of energy education and conservation programs of state and federal organizations, and private industries (electric utilities) acquired by calling or writing the Contact Organizations given on page 3.

Background Information: Because of the energy situation ("crisis") in the United States, federal and independent organizations have been searching for alternatives for this problem for the future. Those alternatives include the development of new energy sources, the improvement of the efficiency of existing fuels, and energy conservation programs. In 1977, President Carter proposed the United States' energy policy through a plan called The National Energy Plan. Several objectives were stressed buy the most important ones were energy conservation and fuel efficiency. Conservation is cheaper than developing new energy supplies and is likewise the most effective means of protecting our environment. Also, conservation of our present energy supplies and improved efficiency can lead to quicker results and seems to be the only appropriate solution for the immediate future.

Background Information: (Continued)

Therefore, the federal government, as well as state and local governments, private industries, etc. have been implementing more and more energy education and conservation programs.

Activity:

1. Describe to the students the type of guide that is to be prepared and the purpose of it. (How will this guide be useful?)

2. State objectives for the guide.

   A. Introduction
   B. Table of Contents
   C. Body of the guide
      1) name of the organizations
      2) description of the organizations
         (a) describe the services the organizations may provide
         (b) descriptions of the types of activities related to energy education and conservation
      3) Complete addresses
      4) Zip code
      5) Telephone number
   D. Conclusion

3. Help the students develop the Table of Contents. A sample format could be as follows:

Section	Table of Contents	Page(s)
I.	Introduction.....	
II.	Energy Education Programs of State Government.....	
III.	Energy Education Programs of Federal Government....	
IV.	Energy Education Programs of Private Industry.....	
V.	Selected Energy Education Publications.....	
VI.	Definitions.....	
VII.	Conclusions.....	

Activity: (Continued)

4. Write or call Contact Organizations listed below to compile information required for the guide.

5. All of the information from the organizations should be separated into the categories listed in the Table of Contents and then alphabetized.

6. Arrange all of the information gathered by the students according to or in the order of the format to be utilized. Be sure to include page numbers at this point.

7. The guide should then be placed in the school library for easy reference.

Follow-up Activities:

1. A student project could be to have the guide updated annually.

2. In addition to completing the guide, students may give written or oral reports on their findings of the various programs on energy education and conservation within the United States.

Contact Organizations:

STATE ORGANIZATIONS

Commission on Women, 518 Finance Building, Harrisburg, PA 17120

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Pennsylvania Cooperative Extension Service, 325 Agricultural Administration Building, University Park, PA 16802

Pennsylvania Department of Agriculture, 2301 North Cameron Street, Harrisburg, PA 17120

Pennsylvania Department of Community Affairs, 216 South Office Building, Harrisburg, PA 17120

Pennsylvania Department of Education, 317 Education Building, Harrisburg, PA 17120

Pennsylvania Department of Environmental Resources, Evangelical Press Building, Box 1467, Harrisburg, PA 17120

Pennsylvania Department of General Services, 515 North Office Building, Harrisburg, PA 17120

Pennsylvania Department of Transportation, 1200 Transportation and Safety Building, Harrisburg, PA 17120

Pennsylvania Public Utilities Commission, 104 North Office Building, Harrisburg, PA 17120

FEDERAL ORGANIZATIONS

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Department of the Interior, Interior Building, "C" Street between 18th and 19th Streets, Washington, DC 20240

U.S. Environmental Protection Agency, Waterside Mall, 401 "M" Street, SW, Washington, DC 20460

PRIVATE INDUSTRY (Electric Utilities)

Pennsylvania Electric Association, 301 APC Building, 800 North Third Street, Harrisburg, PA 17102 (This association maintains a current listing of member utilities of Pennsylvania.)

Pennsylvania Electric Utilities:

Citizens' Electric Company
22 North Third Street
Lewisburg, PA 17837

Duquesne Light Company
435 Sixth Avenue
Pittsburg, PA 15219

Elkland Electric Company
West Main Street
Elkland, PA 16920

Hershey Electric Company
749 East Chocolate Avenue
Hershey, PA 17033

Luzerne Electric Division
UGI Corporation
247 Wyoming Avenue
Kingston, PA 18704

Metropolitan Edison Company
P.O. Box 542
Reading, PA 19603

Contact Organizations: (Continued)

Pennsylvania Electric Company
1001 Broad Street
Johnstown, PA 15907

Pennsylvania Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Pennsylvania Power Company
1 East Washington Street
New Castle, PA 16103

Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101

Pike County Light & Power Company
One Blue Hill Plaza
Pearl River, NY 10965

Rockingham Light, Heat & Power Company
509 Fifteenth Street
Windber, PA 15963

Wellsboro Electric Company
19 Waln Street
Wellsboro, PA 16901

West Penn Power Company
Cabin Hill
Greensburg, PA 15601

Windber Electric Corporation
509 Fifteenth Street
Windber, PA 15963

HEALTH ACTIVITY

RADIATION EFFECTS: A JOURNAL

A CONSUMER'S CONSERVATION PLAN

COAL POLLUTION: AN INTERVIEW

HEALTH ACTIVITY

Title: Radiation Effects: A Journal

Grade: 4 through 9

Energy Objective: To help students understand the nature of nuclear radiation.

Health Objective: Students will develop and apply knowledge of nuclear radiation's effects on the natural environment -- especially on the human sector of that environment.

Materials:
- Newspaper and Magazine Articles
- Content-related References
- Contact Organizations

Background Information: Radiation is energy radiated in terms of waves or particles. It is measured in terms of rems or millirems. Radiation can be natural (e.g. sun) or man-made (e.g. chest x-ray). Over a year's time, the average American is exposed to 100-200 millirems of radiation. This is roughly equivalent to the exposure from 10-20 x-rays. About half of that radiation comes from the sun and cosmic rays, another 45% from exposure to diagnostic and therapeutic medical equipment, and about 5% from atomic fallout and such consumer products as microwave ovens and TV sets; and production of nuclear power. Radiation sickness is almost certain at exposures of about 50,000 millirems. The Federal Government has set a permissible annual level of radiation exposure for the general public of 500 millirems and for nuclear power plant workers, 5,000 millirems. These standards have been sharply questioned. Most of what is is known about the dangers of radiation has come from studies of people exposed to extremely high levels of radiation, e.g. survivors of the A-bombs dropped on Hiroshima and Nagasaki.

However, the accident in the spring of 1979 at Metropolitan Edison's Unit 2, at Three Mile Island near Harrisburg offers an opportunity to observe the effects of a limited, but steady, radioactive release.

Background Information: (Continued)

The precautions taken (and not taken), the immediate medical and food-processing tests, and the many predicted health hazards were based upon scientific and medical assumptions of the effects of the radioactivity. However, the contradictory nature of different reports suggests that only time and constant clinical investigation will reveal the actual effects that The Three Mile Island disaster will have on the people, plant and animal life of the area.

Activity:

1. The activity should be introduced with a class discussion of The Three Mile Island nuclear accident. Special note should be made of all facts for which the students can account.

2. Students are assigned to do original research to gather information concerning the accident, radioactivity, and environmental concerns. The most productive sources would be past issues of newspapers and magazines carrying articles about the incident. If these cannot be acquired, the newspaper and magazine files of a library can be consulted. If possible, the actual article should be provided. However, if that is not possible, students should read and report on the articles, notating date and publisher of the issued article.

3. Students' findings and reports can be compiled in a scrapbook with added annotations. This file can be continued throughout a term or from year to year.

4. The following topics serve to guide student research:

    - condition in humans resulting from excessive levels of radiation.
    - evacuation of pregnant women and preschool children
    - radiation-level testing in humans
    - radiation-level testing in milk and other foods
    - effects on farm animals and crops
    - possible future reactions (cancer, cell mutation, offspring)
    - conflicting reports concerning health effects

Contact Organizations:

American Cancer Society, 777 Third Avenue, New York, NY 10017. Each county in Pennsylvania has a local unit, please contact the local unit which is listed under the white pages in the phone directory.

American Nuclear Society, 244 East Ogden Avenue, Hinsdale, IL 60521

Cancer Information Service, Fox Chase Cancer Center, 7701 Burholme Avenue, Philadelphia, PA 19111, or phone toll-free: 800-822-3963.

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

National Cancer Institute, Bethesda, MD 20014, or phone toll-free: 800-638-6694

Nuclear Regulatory Commission, Office of Public Affairs, Washington, DC 20555

Pennsylvania Department of Agriculture, 2301 North Cameron Street, Harrisburg, PA 17120

Metropolitan Edison Company, P.O. Box 542, Reading, PA 19603

Department of Health, Education and Welfare, 330 Independence Avenue, SW, Washington, DC 20201

National Intervenors, 153 "E" Street, SE, Washington, DC 20003

Pennsylvania Department of Environmental Resources, Evangelical Press Building, Box 1467, Harrisburg, PA 17120

Public Utilities Commission, 104 North Office Building, Harrisburg, PA 17120

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Environmental Protection Agency, Waterside Mall, 401 "M" Street, SW, Washington, DC 20460

HEALTH ACTIVITY

Title: A Consumer's Conservation Plan

Grade: 6 through 9

Energy Objective: Students are guided in developing an awareness, concern, and plan of action to combat energy waste in the production of consumer products.

Health Objective:

1. Provide students with an awareness of the importance and responsibility of the individual in promoting reform.
2. Have students become familiar with agencies which offer aid to the consumer.

Materials:

- List of addresses of companies and government agencies related to consumer protection.
- Telephone book for local dealer's names and addresses.

Background Information: It isn't unusual to buy a product which doens't operate properly or simply doesn't meet your expectations as a consumer. These products are not only a waste of money, but can also cause a waste of energy. A faulty electrical appliance or motor vehicle may drain its power source without performing its expected work. Mechanical irregularities can even cause an electrical or fuel-burning motor to utilize more than a normally functioning machine. Besides this obvious waste, consideration of the energy loss incurred in the production of a faulty product and in the communication and transportation for the repair or replacement must also be taken into account.

It is the responsibility of a conservative-conscious consumer to do what he can to prevent the further sale and production of energy-wasting, faulty products. Furthermore, the consumer's concern for energy conservation may indicate to the manufacturer and producers that the public will not tolerate the abuse of our increasingly valuable energy supplies. The influence of the consumer on production policy can, at times, effect more change than even the strictest government regulations.

Background Information: (Continued)

In the following activity, the plan of action through which students will be guided in relaying complaints to producers of faulty products begins with contacting the local dealer and making him aware of the complaint. If the local dealer cannot offer satisfaction, the next step is to obtain information which would proceed contact with the customer relations department of the company which manufactured the product. May of these companies have toll-free numbers for receiving complaints. If the telephone number or telephone directory, the local library or local Better Business Bureau may provide the information. In all cases, the local Better Business Bureau should be informed of action taken. It might be necessary to write the company and send them copies of records related to the sale and product. If there is no local Better Business Bureau, copies of any correspondence can be sent to Council of Better Business Bureau, 1150 17th Street, NW, Washington, DC 20036.

Should the company fail to consider a complaint, one of the consumer protection agencies listed in Part II of the Contact Organizations should be notified.

Activities: This activity would be an excellent follow-up to the Multidisciplinary Activity, "A Product's Energy Cycle." Awareness of the significant role energy plays in a product's existence will emphasize the importance of consumer concern in conserving that energy.

1. Students are presented with/or develop a "bad situation" involving a faulty product. Following are suggested situation:

    - toaster which doesn't pop when finished toasting
    - oven which responds irregularly to temperature settings
    - lawn mower which consistantly idles too fast
    - refrigerator whose temperature setting cannot be regulated

2. After deciding upon a "bad situation," students list and explain all possible energy waste caused by the faulty product's operation, repair, or replacement.

3. Students develop and outline a plan to remedy the "bad situation."

Activities:
(Continued) (When developing any of the correspondences, students should be encourages to give detailed and factual accounts of their problems.)

a) The local dealer should be contacted. Students should obtain the address and phone number of a local dealer who handles their particular product. A written correspondence or simulated telephone communication should be recorded.

b) Assuming that the local dealer does not or cannot provide repair or replacement, students should prepare a written correspondence or a telephone conversation contacting the manufacturing company. An explanation of the local dealer's position should be provided in this contact.

c) Again assuming no cooperation with the previous contact, students should prepare a written correspondence to a consumer protection agency, explicitly explaining their complaint and demands.

Extension and Follow-up:
(Continued) A hearing in which an arbitration board decides the outcome of a complaint can be simulated. Both the consumer and the manufacturing company or dealer should be represented.

Contact Organizations:

PART I

Consumer Affairs, Chrysler Corporation, P.O. Box 856, Detroit, Michigan

Customer Assistance, Volkswagen of America, Englewood Cliffs, NJ 07632

Customer Relations Department, J.C. Penney Company, 1301 Avenue of the Americas, New York City, NY 10019

Customer Relations Department, F.W. Woolworth Company, 233 Broadway, New York City, NY 10007

Contact Organizations: (Continued)

Ford Refererral Operators: See telephone directory for local dealer, district office, or call: 800-241-3673

Owner Relations, Central Office, General Motors Corporation, 3044 Grand Boulevard, Detroit, MI 48202

Owner Relations Manager, American Motors Corporation, 14250 Plymouth Road, Detroit, MI 48232

PART II

Direct Selling Association, 1730 "M" Street, NW Washington, DC 20036. (For all door-to-door sales.)

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Major Appliance Consumer Action Panel, 20 North Wacher Drive, Chicago, IL 60606. (For home laundry equipment, refrigerators and other major appliances, call collect: 312-236-3156)

Office of Consumer Advocate, Department of Justice, Room 513, Finance Building, Harrisburg, PA 17120

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

HEALTH ACTIVITY

Title: Coal Pollution: An Interview

Grade: 4 through 9

Energy Objective: To help students develop a better understanding of the properties of coal and how these properties effect the environment when coal is used as a fuel.

Health Objective: Students will discover and express the effects of coal pollutants on human health.

Materials:

- Content related References
- Contact Organizations
- Worksheet: "Interview"

Background Information: Large amounts of coal are used to produce steam and generate electricity in the United States. In the coal-fired plants, some of the pulverized coal does not burn, leaving as much as 16 percent of the total weight of the fuel burned to be collected as ash (fly ash). These plants must be equipped with electrostatic precipitators to meet air pollution standards. There are various methods for removing the sulfur contained in the stack gas. These methods are not always very effective and are expensive. In addition to sulfur oxides, oxides of nitrogen are also produced when coal is burned in a boiler. The unused steam produced in these plants is lost in the condenser and to the surroundings. All of these excesses constitute the pollution created by an electrical generation plant using coal as its fuel.

The following excerpt describes the most devastating effects which can result from the existance of coal-fired industry:

> Donora, Pennsylvania, is a small industrial community located on the inside curve of a horseshoe-shaped river valley. Until October, 1948, it was not well known. It was just one of the countless towns where people lived and worked. But in that month, Donora suffered

Background Information: (Continued)

an air-pollution disaster. A fog descended - fog that was turned into smog by dirt particles, and that reeked with the odor of sulfur dioxide. For four days the smog remained. During that short time, twenty people died, although the average number would have been two. And 6,000 people of the 14,000 who lived in the town suddenly became ill with sore throats, headaches, vomiting, and burning eyes. A large number of cats, dogs, and birds died.

The reason for the sickness and deaths was that a temperature inversion had bottled up the pollution from the town's steel mills, a wire factory, a zinc plant, and a coke plant. Waste gases such as sulfur dioxide, coal smoke, and zinc fumes poured into the blanket of fog, making it more deadly with each passing hour.

On the afternoon of the fourth day of the killer smog, rain began to fall, and the pollution was cleared away. Everyone knew, however, that it could come back at any time unless conditions in the industrial plants were corrected*

* Shuttlesworth, Dorothy E., Clean Air - Sparkling Water, Doubleday and Co., Inc., (New York: 1968), pp. 48-50.

Activities:

1. Students are presented with the following situation:

The following article appeared in a November issue of a Pennsylvania newspaper:

KILLER FOG HITS ASHTOWN

ASHTOWN, PA - Three days ago, a heavy soot, and ash-filled fog descended upon Ashtown, Pennsylvania, and has not lifted. The small industrial community has suffered 25 casualties, as well as, many taken ill. Officials cite the giant coal-fueled power plant as the major cause of the disaster. The thermal inversion which has trapped the smog over the city is not expected to lift for at least 24 hours.

Activities:
(Continued)

2. Each student, taking the role as a doctor from Ashtown, will be the subject of an interview concerning the disaster. Before completing the interview, students must do individual research related to the questions being posed.

3. Each student completes the worksheet "Interview of Dr. _____".

4. Students should share their answers from the worksheet.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Pennsylvania Department of Environmental Resources, Evangelical Press Building, Box 1467, Harrisburg, PA 17120

Pennsylvania Department of Health, Bureau of Health Research, P.O. Box 90, Harrisburg, PA 17120, or phone: 717-787-5264

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

U.S. Department of Health, Education and Welfare, 330 Independence Avenue, SW, Washington, DC 20201

U.S. Environmental Protection Agency, Waterside Mall, 401 "M" Street, SW, Washington, DC 20460

INTERVIEW OF DR. _____

DATE _____ PLACE _____

REPORTER (RP): Dr. _____, how long have you been a physician in Ashtown?

DOCTOR (DR):

RP: Do you believe that coal pollutants are the primary cause of this disaster? Why or why not?

DR:

RP: What is a thermal inversion? What part did it play in bringing about this deadly smog?

DR:

RP: How long has the power plant been in operation?

DR:

RP: Has the pollution from the plant always been at the level it is now? What can cause changes in the pollution level?

DR:

RP: Exactly what chemicals are found in the wastes released into the air from the coal plant?

DR:

RP: What type of coal does the plant use? Are there any types of coal which have a lower sulfur-content?

DR:

RP: Does the plant employ any type of pollution control? If so, why have they not prevented this disaster?

DR:

RP: What harmful effects do the pollutant chemicals have on human health?

DR:

RP: What types of symptoms have you had to treat since the beginning of the disaster?

DR:

RP: What caused the death of the 44 people?

DR:

RP: Will there be extended or any long-range effects of this disaster? If so, what might they be?

DR:

RP: Could this disaster ever happen again? Could you explain that answer?

DR:

RP: Could it be prevented from happening again? How?

DR:

MULTIDISCIPLINARY ACTIVITY

HOME ENERGY AUDIT

A PRODUCT'S ENERGY CYCLE

MAJOR ENERGY SOURCES

THE ENERGY PROBLEM

CLIMATE CONTROL DESIGN

ENERGY QUOTIENT

CONSERVATION VS. "THE CRISIS"

ENERGY SOURCES TIME LINE

MULTIDISCIPLINARY ACTIVITY

Title: Home Energy Audit

Grade: 4 through 9

Energy Objective: To help students develop a better understanding of opportunities for conserving energy in the home.

Multi-disciplinary Objectives:

Language Arts: The child will be able to practice skills in research, letter writing, organization, and outlining.

Math: The child will be able to practice skills in simple calculations (addition, subtraction, multiplication, and division) and measurement.

Health: To instill a sense of values and priorities in the students.

Social Studies/Science: To develop an awareness among students that our major sources of energy (fossil fuels) are depleting much more rapidly than they are forming in the earth and that, as a result, energy conservation should be a "responsibility" of every U.S. citizen.

Materials: Duplicate the checklist provided in this activity and contact the organizations listed on page 3 for specific information on insulation, storm windows, doors, etc.

Background Information: Energy costs have sky rocketed since the oil embargo of 1973. The home utility bill has become the fastest growing expense for many families. In descending order, most energy is used in the home for heating, cooling, water heating, lights, small appliances, refrigerators, clothes drying and cooking, and the TV, washing machine and dishwasher.

Background Information (continued): There is a great deal you can do to save energy and money in your home. By carefully reviewing material collected from the Contact Organizations and utilizing the following checklist to conduct an energy audit, you will be able to achieve substantial savings.

Activities:

1. Have students collect information from Contact Organizations on energy conservation for their home.

2. Duplicate the Home Energy Audit. Distribute it to the class and allow a specified amount of time to complete it.

3. After the allotted amount of time, have students return their audits. Note that any checkmark in the No column indicates an opportunity to conserve energy.

4. Use this checklist to develop a management program for your home. Consider the following when setting up the program:

   a. which opportunities can be implemented at no cost?
   b. which opportunities offer the greatest savings for the amount of money invested?
   c. which ones can be implemented at minimum cost, e.g. under $100.
   d. which ones require the highest expenditures, e.g. $100 or more?

   (Take care in developing your program. It would be senseless to spend $2,000 to save energy with a particular home improvement if another improvement would save you the same amount of energy with only a $100 investment.)

5. Incorporate the management plan for a specified amount of time. (Example: 1 or 2 months)

6. Conduct the same energy audit again. Were there fewer checks in the No column? Check your utility bill--was it lower? (These can be used to check the success of your program.) Were you successful? If not, why?

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Information Office, U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

Air Conditioning and Refrigeration Institute, 1915 N. Ft. Myer Drive, Arlington, VA 22209

American Institute of Architects, 1735 New York Avenue, NW, Washington, DC 20006

American Society of Heating, Refrigeration and Air Conditioning Engineers, Incorporated, 345 East 47th Street, New York, NY 10017

Association of House Appliance Manufacturers (AHAM), 20 North Wacker Drive, Chicago, IL 60606

National Mineral Wood Insulation Association, Incorporated, 211 East 51st Street, New York, NY 10022

Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, OH 43659

Also contact local utility representatives (see address and telephone number on bills or refer to the yellow pages in your telephone directory.)

ENERGY CONSERVATION CHECKLIST FOR THE HOME

		Yes	No
	Heating and Cooling		
1.	Thermostat set below 68°F in winter.	____	____
2.	Thermostat set above 79°F in summer.	____	____
3.	Thermostat set back at night to 55° in winter.	____	____
4.	Thermostat lowered to 50° when away for long periods in winter.	____	____
5.	House plants or water pans used to increase humidity levels.	____	____
6.	Remove dust from radiators.	____	____
7.	Turn ducts and radiators off in unused areas.	____	____
8.	Close outside doors quickly.	____	____
9.	Utilize sunlight for lighting and space heating.	____	____
10.	Arrange furniture so air flows are free from obstructions.	____	____
11.	Close windows tightly in winter.	____	____
12.	Close fireplace dampers when not in use.	____	____
13.	Prevent lights and heating sources from affecting thermostats.	____	____
14.	Alter clothing instead of adjusting thermostats.	____	____
15.	Turn gas pilot light off in summer.	____	____
16.	Turn air conditioner off when you leave home.	____	____
17.	Keep coal furnace fire door closed and remove ashes frequently.	____	____
18.	Turn the water heater off when away for extended periods. In winter, drain all pipes if danger of freezing exists.	____	____
19.	Inspect heating, cooling and ventilating systems.	____	____

		Yes	No
	Lighting/Electricity		
20.	Turn out all unnecessary lights.	____	____
21.	Keep light fixtures clean.	____	____
22.	Replace lights with low watt bulbs.	____	____
23.	Place lamps effectively.	____	____
24.	Use electricity in off peak hours in your area. Consult your local utility company.	____	____
25.	Wash dishes by hand.	____	____
26.	Use convenience appliances as little as possible (e.g. electric can opener).	____	____
27.	Keep tools and equipment off when not in use.	____	____
	Water		
28.	Set hot water temperature below 130°F.	____	____
29.	Take showers instead of baths. Use as little water as possible.	____	____
30.	Put a water saving device in the toilet tank.	____	____
31.	Use sink stoppers when washing dishes and shaving.	____	____
32.	Use cold water cleaning procedures.	____	____
33.	Keep a pitcher of water in the refrigerator for drinking water.	____	____
	Transportation		
34.	Maintain a steady speed when driving. Don't exceed speed limits.	____	____
35.	Properly inflate tires.	____	____
36.	Plan to reduce total energy consumption.	____	____
37.	Turn the enginer off if idling for more than one minute.	____	____

		Yes	No
38.	Walk and ride bikes.	____	____
39.	Avoid using energy consuming automobiles and options.	____	____
	Cooking/Baking		
40.	Defrost foods before cooking.	____	____
41.	Cook oven dishes at the same time.	____	____
42.	Never use the oven for space heating.	____	____
43.	Adjust gas flames and pilot lights properly.	____	____
44.	Turn off ovens and burners immediately when through cooking.	____	____
45.	Limit oven preheating to five minutes.	____	____
46.	Keep heat reflectors below burners clean.	____	____
47.	Fit pots and pans to burner size.	____	____
	Refrigeration		
48.	Empty and disconnect the refrigerator when away for long periods.	____	____
49.	Defrost the freezer.	____	____
50.	Open refrigerator, freezer, and oven doors only as necessary.	____	____
	Laundry		
51.	Wash and dry only full loads of dishes and clothing.	____	____
52.	Dry clothes in consecutive loads.	____	____
53.	Keep filters and screens clean.	____	____
54.	Air dry clothes.	____	____
	Packaging, Etc.		
55.	Substitute compost for fertilizer as much as possible.	____	____

		Yes	No
56.	Avoid packaged, pre-cooked foods.	____	____
57.	Avoid overpackaged goods.	____	____
58.	Utilize recyclable products and containers.	____	____
59.	Roll up newspapers and burn them in the fireplace (don't burn papers with color print).	____	____

Insulation/Weatherization

60.	Sufficient roof insulation, R-30-33 in Pennsylvania.	____	____
61.	Sufficient wall and floor insulation, R-19 in Pennsylvania.	____	____
62.	Storm windows and doors installed.	____	____
63.	Air leaks properly sealed.	____	____

MULTIDISCIPLINARY ACTIVITY

Title: A Product's Energy Cycle

Grade: 6 through 9

Energy Objective: Students will gain an awareness of energy's role in the production, commercialism, operation, and maintenance of a product.

Multi-Disciplinary Objectives:

Language Arts: Students will do research to complete an outline. Each topic of the outline represents a main idea for which the students find specific details.

Social Studies: Students will discover the geographic location of the source of raw materials, the means and extent of necessary transportation, and the means of production associated with a given product.

Science: Students will assess the type of energy involved in the acquistion of raw materials, transportation of related materials, processing of a product, advertising and sale of a product, and the actual operation and maintenance of a product. Students will also become aware of any energy transfers which occur during production.

Health: Students will clarify or establish values in assessing the worth of a product by comparing its role in fulfilling human need to its energy consumption.

Materials:

- Encyclopedias; textbooks and other content-related reference books
- Maps showing the location of raw materials
- Manuals and pamphlets explaining the operation, maintenance, and repair of the products being researched
- Energy Cycle Outline
- Evaluation and Values Questions

Background Information: In the following activity, completion of the outline provides the information upon which value judgements are to be made when answering the three evaluation questions. An investigation of a product's energy-life cycle offers an awareness of the significance of energy's role in everyday living. An explanation of the outline's requirements begins with production, specifically, the types of materials used, the energy involved in their acquisition and the energy required to process them in creating the product. Transportation of the raw materials to the processing site and of the product to the commercial outlet and/or to the consumer is the next point of the energy-consumption investigation. Energy involved in commercialism would include any form used in the display, advertisement, or actual selling of the product. Any and all types of energy which the product uses to fulfill its intended purpose is considered operation energy. Finally, the maintenance of the product's maximum efficiency may require physical labor (chemical, heat, and mechanical energy), transportation (chemical, heat and mechanical energy), cleaning (chemical and mechanical energy), or other processes which involve a variety of energy types. By creating this picture of a total energy cycle, one can decide if the product's energy-expenditure is justified by its contribution to society and its needs.

Activity: In order to complete the following activity, students must have a basic knowledge of the type of work which is associated with the various types of energy.

1. Students choose, or are assigned, a product for research. The following list offers possible areas of consideration:

   - furniture
   - electrical appliances
   - transportation devices
   - materials found in the classroom
   - recreational equipment
   - foods

2. Students are instructed in doing research to complete the Energy Cycle Outline.

3. Students use their completed outline in answering the three Evaluation and Values Questions.

Extending Activity: The students can reevaluate the energy cycle of the product, making suggestions as to how energy might be conserved.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

Major Appliance Consumer Action Panel, 20 North Wacker Drive, Chicago, IL 60606 (for home laundry equipment, refrigerators and other major appliances, call collect: 312-236-3156).

Office of Consumer Advocate, Department of Justice, Room 513, Finance Building, Harrisburg, PA 17120

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

ENERGY CYCLE FOR _____
(products name)

I. Production Energy
   A. Materials Used
   B. Production Process
      1. Energy used in getting materials
      2. Energy used in actual production

II. Transportation Energy
   A. Moving Raw Materials to the Production Site
   B. Moving Product to Commercial Outlet and/or Consumer

III. Commercialism Energy
   A. Display and Advertising
   B. Sales of Product

IV. Operation Energy

V. Maintenance Energy

EVALUATION OF VALUES QUESTIONS

1. In what ways does this product conserve energy, make work more convenient, provide more free time, or make free time more pleasurable?

2. Was this product primarily developed out of necessity for convenience, or strictly for pleasure?

3. How would you assess the benefits this product offers in relation to the amount of energy required to allow you to have it?

MULTIDISCIPLINARY ENERGY EDUCATION ACTIVITY

Title: Major Energy Sources

Grade: 4 through 9

Energy Objective: To help students develop a better understanding of our major energy sources, their composition/origin, location, extraction/conversion, uses, and advantages and disadvantages of using them.

Background Information: Our major energy sources include petroleum, natural gas, coal, hydropower, nuclear fission, oil shale, tar sands, coal gasification, geothermal, solar, tidal, wind, hydrogen fuel cells, magneto hydrodynamics (MHD), burning of trash, nuclear fission (breeder reactor), and thermo nuclear fusion.

Activity: Students should collect information from the school or public library and Contact Organizations given on page 3. Findings should be used in developing a chart depicting the composition/origin, location, extraction/conversion, uses, and advantages and disadvantages of each major energy source given under Background Information above. Other activities include:

1. Determine estimated reserves (state, national, global) of each source of energy or fuel-petroleum, natural gas, coal, uranium, oil shale, and tar sands.

2. Prepare maps (state, national, global) depicting the specific locations of the sources of energy given in number 1 above.

3. What are the characteristics of good energy sources? (Consider available supply, high energy potential, ease of obtaining, evnironmental effects, etc.).

4. Use the characteristics of a good energy source in number 3 above and make comparison, of the various energy sources.

5. Research and discuss which nations have control of most of the major energy sources and their specific contribution to energy technology.

6. How could the control of a major energy source by one nation result in conflict in other nations?

7. List the major problems caused by fossil fuel energy shortages.

8. Study careers related to energy resource development and use.

9. Prepare and maintain an energy current events scrapbook by collecting information about energy from newspapers.

10. Contact your local electric utility and request a copy of their annual report. Find out what kinds of fuel they use, the price paid for it, price they charge for electricity, and the margin of profit.

11. Do a report (verbal or written) discussing our major renewable energy source-- solar radiation, the heat of the earth, tidal energy, and wind energy.

12. Write a report describing the factors which effect the available supplies of a specific energy source at a given time.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

MULTIDISCIPLINARY ENERGY EDUCATION ACTIVITY

Title: The Energy Problem

Grade: 4 through 9

Energy Objective: To help students develop an understanding of the energy problem, its impacts, and what we can do to ease it and prepare for the future.

Background Information: Energy shortages occur because of the following circumstances: poplulation increases, increasing demands for more of everything (travel, greater production, appliances, etc.), competition scarcity, and lack of availability. The Middle East Oil Embargo in 1973-74 hastened the impact of the energy problem and since that time the United States has not been able to increase production or conserve enough energy to become energy independent. The United States is currently facing another energy crises-- a fuel shortage.

Activities: Have students do the following to learn more about the energy problem:

(1) Write a newspaper article describing how a fuel shortage can disrupt family life.

(2) Prepare a graph depicting supply and demand. Display this on the school bulletin board.

(3) Take a field trip to a local oil refinery. Write a report on the findings.

(4) Prepare comprehensive listings of ways to conserve energy and distribute them to members of the community.

(5) Prepare a listing of the things family members are willing to give up-- appliances, travel, etc. Have each member of the family priority rate the things/items.

(6) Organize a contest at home to see whose family can use the least energy for one week.

Activities: (Continued)

(7) Design and display posters which will encourage others to conserve energy.

(8) Write your Congressman and/or Senator to find out what the Federal Government is doing to lessen the energy problem.

(9) Write your own energy conservation ethics and practice it daily.

(10) Prepare and implement energy management plans in the home and at school.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, 20 Massachusetts Avenue, Washington, DC 20545

MULTIDISCIPLINARY ACTIVITY

Title: Climate Control Design

Grade: 6 through 9

Energy Objective: Students will be exposed to ways in which a house can be designed to utilize certain environmental factors and simultaneously eliminate or reduce the effects of other natural factors to conserve energy and reduce the resultant costs.

Multi-disciplinary Objectives:

Science: Students will develop or apply the following skills and principles:

1. scientific principles behind structures designed for heat collection and retention
2. principles of the greenhouse effect
3. principles behind insulation

Social Studies:

1. students will develop or apply a knowledge of an area's geographic characteristics and associated climate in designing their model house
2. students will consider structural designs of other cultures and time periods in designing their model house

Art: Students will draw a floor plan and at least one exterior, three-dimensional view of their model house.

Math: Students will apply measurement skills in designing and drawing their model home.

Language Arts: Students will organize accumulated research.

Materials: Content-related reference books and Contact Organizations.

Background Information: Large capacity solar space heating would add at least $8,000 to the cost of building a new home. Even though such a home would have a solar system which would last a lifetime and probably pay for itself in about fifteen years, this investment may not seem attractive to a buyer. The initial financing may be difficult to arrange, the buyer may not intend to own the house for a very long period of time, or perhaps the buyer feels installation cost will decrease in several years. However, even though the idea of installing a complete solar heating system is initially rejected, provision can and should be made in the house design to utilize or control existing climatic factors.

There are many different techniques and devices for controlling climatic factors in house design. One very critical technique is structure form. In planning the shape of the house, internal retention and external (solar) gain of heat, wind resistance, and natural air flow should all be considered. Different types of climate dictate differently shaped structures. The Eskimo igloo, the Swiss chalet, and the Indian hogan and teepee are all dwellings constructed to adapt to climatic conditions. The placement and size of a fireplace and its chimney can play a vital role in heating. A look back at the homes of early America can reveal much about well planned internal zoning and this early means of heating. Window design, attached greenhouses, insulation and landscaping can also play a significant role in controlling and harnessing natural sources. Even the addition of a solar water-heating kit or an auxiliary solar space heating unit would not raise the initial financing cost much over about $2,000. Furthermore, with such careful designing, a complete solar heating system could easily be added when the investment would seem more suitable.

Activity:

1. Students are introduced to the concept of climate control design.

2. Students do research to discover specific techniques and devices for controlling and utilizing climatic factors. The following are suggested areas of research:

structure shape	primary and auxiliary heating
insulation	building materials
greenhouses	roof design
window design	foundation structure
landscaping	internal zoning

3. Students share research findings in whole class discussion or even a charted list.

4. Students use accumulated information to plan a house with a climate control design. The following features are required for the project:

   - internal floor plan with precise and indicated measurements
   - exterior three-dimensional view showing controlling features and any significant landscaping
   - additional exterior views would be optional

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

National Solar Heating and Cooling Information Center, P.O. Box 1607, Rockville, MD 20850

Solar Energy Industries Association, Incorporated, Suite 632, 1001 Connecticut Avenue, NW, Washington, DC 20036

Solar Energy Research Institute, 1536 Cole Boulevard, Golden, CO 80401

Solar Energy Services, P.O. Box 2166, Hendersonville, NC 28739

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

MULTIDISCIPLINARY ACTIVITY

Title: Energy Quotient

Grade: 4 through 9

Energy Objective: To assess the students' general knowledge of energy.

Multi-disciplinary Objectives:

Language Arts: To develop skills in reading comprehension.

Math: To evaluate the students' understanding of various units of measuring heat energy, light energy, electrical energy, etc., what R-values represent, and the percentages of energy consumption in Pennsylvania and the United States.

Science: To assess the students' understanding of:

a. major fossil fuels in the United States
b. how fossil fuels were formed
c. the abundance of each in Pennsylvania and the United States
d. other sources of energy (renewable resources) other than the use of nonrenewable resources such as fossil fuels
e. the efficiency of various sources of energy

Social Studies: To evaluate the students' understanding of:

a. supply and demand
b. the United States' energy imports and exports
c. the laws and regulations dealing with energy conservation in Pennsylvania and the United States
d. varying points of view as to when fossil fuels will be completely exhausted
e. the major sources of energy in the United States at various times in the past
f. the advantages of energy conservation

Health: To determine the awareness among students as to the pollution created when fossil fuels are burned to produce energy and the advantages of recycling.

Background Information: This examination was prepared to be used as:

Background Information: (Continued)

1. a pre-test to assess the students' general knowledge of energy prior to instruction in the field of energy conservation

2. as a post-test to determine any change or increased knowledge in this area

Activities:

1. Administer the examination as a pre-test.

2. Correct the examination and record any strengths or weaknessess in the areas of fossil fuels, sources of energy, conservation options, etc.

3. Use the results of the exam to plan additional instruction in the areas which show a weakness. Knowledge can be gained:

   a. through instructional activities provided
   b. from information compiled from Contact Organizations, reference books, etc.

4. Administer the same examination again. (Use it as a post-test here). Correct the exam and record the results. Note any change or increased knowledge in the areas where the students showed weaknesses on the pre-test.

ENERGY QUOTIENT EXAMINATION

Answer Sheet

Instructions: Circle T for True and F for False

Name (Optional)_____ Date_____ 19____

T F 1. Our major fuels are called fossil fuels because they are derived from animal and vegetable remains.

T F 2. Our three principal fossil fuels are petroleum, coal, and uranium.

T F 3. Three nonfossil sources of energy include: sun, wind, and falling water.

T F 4. Our most abundant fossil fuel is coal.

T F 5. The automobile and space heating are responsible for taking over half of the average American family's energy budget.

T F 6. The turbines which generate electricity are less than 50 percent efficient.

T F 7. The unit used commonly to measure potential or kinetic energy is the KWH.

T F 8. The most abundant fossil fuel in Pennsylvania is coal.

T F 9. Recycling extends the life of products, cuts consumption of natural resources, and reduces litter.

T F 10. The goal of Project Independence was national energy self-sufficiency by 1990.

T F 11. Higher fuel prices will provide an incentive for exploration and development of new sources of energy and conversion methods.

T F 12. The United States exports more energy than it imports.

T F 13. Coal, oil, and natural gas supply roughly 90 percent of the energy consumed in the United States.

T F 14. Pessimists believe oil and gas may be exhausted as soon as ten or fifteen years from now.

T F 15. Rising prices will induce people to use less energy.

T F 16. From 1960 to 1971, the price of oil imported into the United States was less than $4 ber barrel.

T F 17. All fossil fuels (oil, natural gas and coal) affect air quality when they are burned to create energy.

T F 18. The BTU (British Thermal Unit) is a measure of heat.

T F 19. In 1850, wood was the major source of energy in the United States.

T F 20. In 1910, coal was the major source of energy in the United States.

T F 21. In 1970, petroleum and natural gas were the major sources of energy in the United States.

T F 22. An important advantage of energy conservation is that it gives us more lead time to develop new technologies.

T F 23. Coal is cleaner, easier to handle, more versatile, and less polluting than oil and gas.

T F 24. About 40% of our total energy is consumed by industry.

T F 25. Ceilings in Pennsylvania homes should be insulated to an R-value of 30-33.

ENERGY QUOTIENT EXAMINATION

Answer Key

1.	T	14.	T
2.	F	15.	T
3.	T	16.	T
4.	T	17.	T
5.	T	18.	T
6.	T	19.	F
7.	F	20.	T
8.	T	21.	T
9.	T	22.	T
10.	F	23.	F
11.	T	24.	T
12.	F	25.	T
13.	T		

MULTIDISCIPLINARY ACTIVITY

Title: Conservation vs. "The Crisis"

Grade: 4 through 9

Energy Objective:

1. To make students aware of the impending energy crisis which threatens our society because of our dependence upon nonrenewable resources.
2. To make students aware of how that crisis will effect different realms of the society--especially their own personal lives.
3. To help students learn and devise ways of combating and preventing the devastating effects of an energy crisis.

Multi-Disciplinary Objectives: Students will develop and apply skills and concepts from several different subject areas in their development of the display chart, the newspaper articles, and the pamphlets required in the Activity sections.

Materials:

- Content-related references
- Contact Organizations
- Magazines and other materials to make pamphlets.

Background Information: Americans are slowly becoming more aware of an energy shortage and an impending energy crisis. Increased demand, brought about by rising population and development of fuel-demanding technology; market competition and monopolization; and a dwindling supply of nonrenewable resources are all factors which have created the present day critical energy situation. The Middle East Oil Embargo in 1973-1974 hastened the impact of the energy problem, and since that time the United States has not been able to increase production or conserve enough energy to become energy independent.

Background Information: (Continued)

However, the goal to achieve United States energy independence is not out of reach. Americans must be made aware of the urgency of practicing conservation methods and developing nonfossil-fuel energy sources. Even more, the individual must be made to realize and accept his fundamental role and responsibility to combating the energy crisis.

Activities:

I. Impending Energy Crisis

Students construct a bulletin board display. The primary feature of the display is a large bar graph showing the expected life-span of present energy sources.

The United States has enough
- GAS to last 14 years
- PETROLEUM to last 15 years
- GEOTHERMAL ENERGY to last 50 years
- OIL SHALE to last 80 years
- COAL to last 200 years
- NUCLEAR FUEL to last 25 years, with the Breeder Reactor 2,000 years
- SOLAR ENERGY to last an unlimited amount of time

The display should also depict the fact that gas and petroleum account for 75-80% of our fuel consumption.

II. The Crisis Strikes

Students write newspaper articles dated 20 years in the future when the United States oil and natural gas supplies have been depleted and foreign importation is too costly to be a usable alternative. The students' articles should reflect resultant specific problems in the following areas:

Industry	Arts and recreation
Transportation	Education
The home	Technology

III. How to Avoid the Crisis

Each student designs and constructs a pamphlet describing a means of conserving energy or making the United States more energy independent. The following are general topics which should be broken down into more specific topics:

Activities:
(Continued)

- Transportation
- Industrial use
- Government involvement
- Conserving energy in the home
- Development of alternative energy sources
- Climate control design

Student pamphlets should contain the following features:

- Title
- Explanation of the type of energy being conserved and the reason for the need of conservation in that area
- Diagrams, sketches, magazine pictures, or charts to illustrate ideas
- Names and addresses of related organizations which can supply more information concerning the energy conservation method being described (See LANGUAGE ARTS ACTIVITY "Energy Education Resource Guide for Pennsylvania")
- (Optional) slogan or jingle to emphasize conservation
- Explanation of conservation method, outlining a definite plan of action for one to follow.

Contact Organizations:

Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

MULTIDISCIPLINARY ACTIVITY

Title: Energy Sources Time Line

Grade: 5 through 9

Energy Objectives: To guide students in the awareness of the development of energy sources from the time of primitive man until the present and the possibilities of energy sources for the future.

Multi-disciplinary Objectives:

Language Arts: The child will be able to practice skills in research, spelling, and written communication.

Math: The student will practice skills in measurement, addition, subtraction, division, and problem solving.

Social Studies: The child will be able to distinguish between the periods of time B.C. and A.D. and develop an understanding of the history of energy sources through the construction of a time line.

Science: The children will become aware of the harnessing of energy through the years and the people responsible for discovering ways of turning one form of energy into another.

Art: The children will be able to make a mural of a time line representing the history of energy sources and practice skills in drawing and painting.

Materials: Information Chart (attached), butcher paper, paints, ruler/yard sticks, reference books, and information from Contact Organizations on page 3 .

Background Information: All human life depends upon energy which comes primarily from the sun. Plants need the sun's rays in order to produce food. Animals and man use energy found in food to operate their muscles and bodies. Until humans learned to make fire, man's only source of energy was his own strength, which he derived from eating plants. Then, around 500,000 B.C., man learned to make fire. The Egyptians invented sails and used the energy from the wind

Background Information: (Continued)

to propel their boats by 3,200 B.C. Water wheels also harnessed the power of falling water. By 2,500 B.C., the Babylonians were using some crude oil and before 1,000 B.C. the Chinese used some coal, but very little.

Up until the late 1700's, wood ranked as the most important fuel. But, as a result of timber growing scarce, coal gradually took the place of wood. In 1698, Thomas Savery invented the steam engine, which became the chief source of power for industry and transportation during the Industrial Revolution. Steam (which was produced from coal) was the main source of energy for Americans until the mid-1800's when Michael Faraday discovered a way to turn mechanical energy into electrical energy. He discovered that generators could produce electricity from the turning of a water wheel or a steam turbine. In 1860 Jean Lenoix invented the internal-combustion engine which brought about the use of gasoline, a by-product of petroleum. When the first gasoline automobile was invented the demand for gasoline, and consequently oil greatly increased. Around 1870-1880 natural gas was a main source of fuel. Since the mid-1800's (1850) the fossil fuels of coal, oil, and natural gas have been our primary sources of energy in the United States until the present time.

Nuclear, geothermal, and solar energy, hydroelectric power, and shale oil provide a very small percentage of the world's energy supply today. However, these are definitely potential energy sources for the future.

Activities:

1. Describe to the students the purpose of a time line and the type of time line they will be making.

2. Have students complete research on energy sources of the past until the present time and the possible energy sources projected for the future. The students should then prepare a sequential listing of these sources on the information sheet provided, along with the approximate date of discovery/use, and the people responsible for that discovery or use. (An example is given on the information sheet).

3. Lead the students in the construction of the time line.

   a. Determine approximately when the time line should begin and end.

   b. Determine and list sources discovered before Christ (B.C.). Figure the approximate number of years covered during this particular period of time.

Activities: (Continued)

c. Determine and list the sources discovered after Christ (A.D.). Figure the number of years covered during this period of time.

d. Determine the number of inches that will represent a specified amount of time for B.C. Do the same for A.D. (Example: 1/2" equal to 100 years. Since the span of time for B.C. will be so great, you might want to let 1/2" represent 10,000 years).

e. Plot the time intervals and label them on the time line.

f. Record the important dates discovered in Part 2 of the Activities on the time line.

g. Draw and paint a picture above or below the correct date on the time line to represent the energy source or transformation, period of time, or person or group of people responsible for the discovery of the energy sources listed on the information sheet.

Extending Activity: Have students research and determine historical events that coincided with the discovery of various energy sources. (Ex. the Industrial Revolution, the Civil War, World Wars I & II, etc.). Plot these dates on the time line and label.

Contact Organizations: Governor's Energy Council, 1625 North Front Street, Harrisburg, PA 17102

U.S. Department of Energy, Information Office, 20 Massachusetts Avenue, Washington, DC 20545

Information Sheet

Source of Energy	Year (approx.) of Discovery/Use	Group of People/Man Responsible for Dsicovery
Ex. Wood (Fire)	500,000 B.C.	Primitive Man (Early Man)
SOURCES OF FUTURE?		
Solar Energy	2,000 ?	?